HUMAN RESEARCH ON LACTATE

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The accumulation of lactate acid in the brain in association with hypoxia causes edema and tissue necrosis (2,5,6). Current methods of detecting intrapartu lactate acid accumulation are not entirely satisfactory. As has been shown the intracellular lactate acid accumulation in the brain tissue can be approximately estimated by detection of changes of lactate concentration in the fetal blood. In this way a detection of changes of lactate acid concentration in the fetal blood should be a precise indicator of the degree of fetal stress during labour (1,7).

During a clinical trial we evaluated the question to what extend it is possible to estimate the lactate in the fetal blood by measuring other biochemical parameters.

Method

This investigation was performed in 125 high-risk-deliveries where lactate acid was measured by means of an encymatic test (Boehringer). Samples were either collected using the fetal blood sample-technique by Saling or by sampling fetal blood from the umbilical artery at the moment of delivery. Additionally capillary blood samples were collected from the mother. The synchroneously collected data were compared by using the linear correlation analysis, the sensitivity, the specifity, the negativ predictive value and the positive predictive value.
The parameters compared were the P_{O_2}, P_{CO_2}, BE, pH and the PH qu 40. Furthermore the linear correlation between the difference of the fetal and maternal BE and the lactat in the fetal blood was calculated (4).

Results

As the mean value of lactate concentration in the samples of fetal blood collected during delivery (FBA) we calculated 2.96± 1.51 mmol/l. The value of the samples from the umbilical artery (UA) was significantly higher (2a = 0.05). Here we found a value of 3.87±1.78 mmol/l. While maternal values collected during labour were not statistically different from fetal values, fetal values exceeded the maternal values at the moment of delivery (Fig. 1). Comparing the values of the lactate concentration in the fetal blood with the other biochemical parameters we found in most items a statistically significant correlation, but though due to the amount of scattering of the values the correlation coefficients were low (<0,5) Fig. 2 - 6). An overview of our statistical evaluation is given on table 1 (tab. 1). For the P_{CO_2} and P_{O_2} we did not find a significant correlation between these value and lactate acid concentration in the fetal blood - collected from the umbilical artery. The sensitifity, the specifity, the positive predictive and the negative predictive value were calculated. Comparing the data of the fetal blood we used a cut off point for the lactat concentrations of 3 mmol/l, P_{CO_2} 55 mmHg, P_{O_2} 15 mmHg, BE 6 mmol/l, pH 7.25, pH qu 40 7.25.

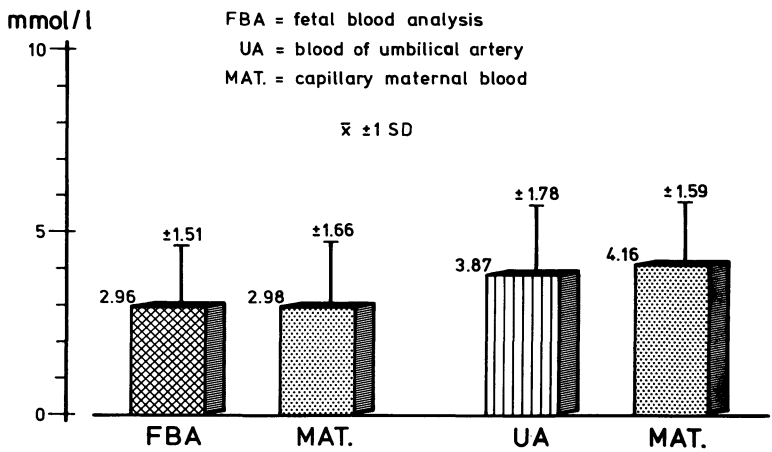

Fig. 1 Mean value (x) and standard deviation (SD) of the lactate concentration (mmol/l) in synchroneously collected scamples of maternal and fetal blood.

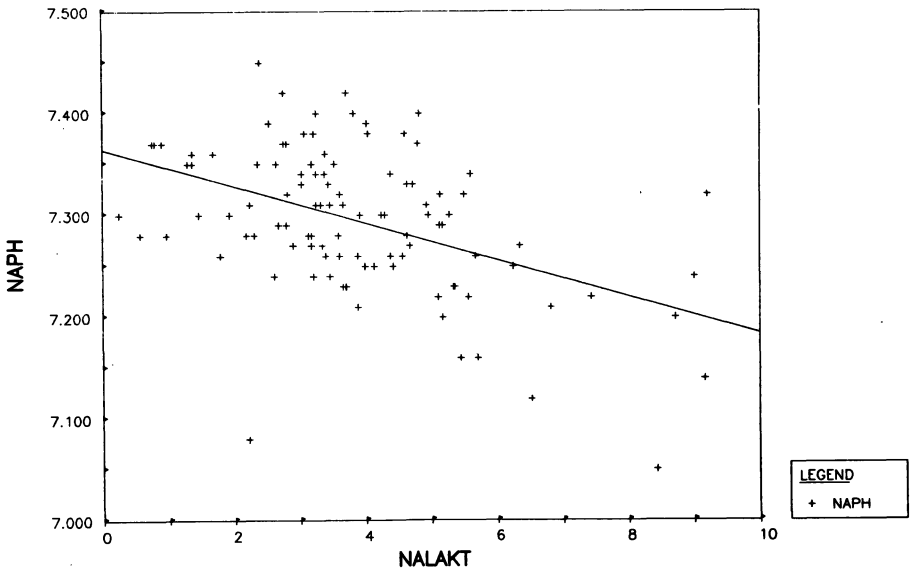

Fig. 2 Correlation between the lactate concentration (mmol/l) and the pH in blood samples from the umbilical artery (UA).

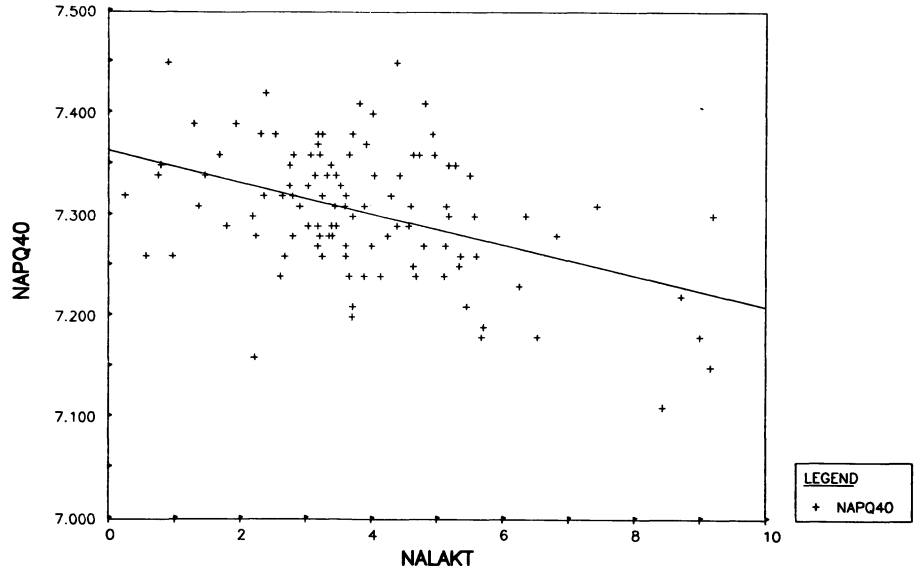

Fig. 3 Correlation between the lactate concentration (mmol/l) and the pH in blood samples from the fetus after equillibration at a P_{CO_2} of 40 mmHg.

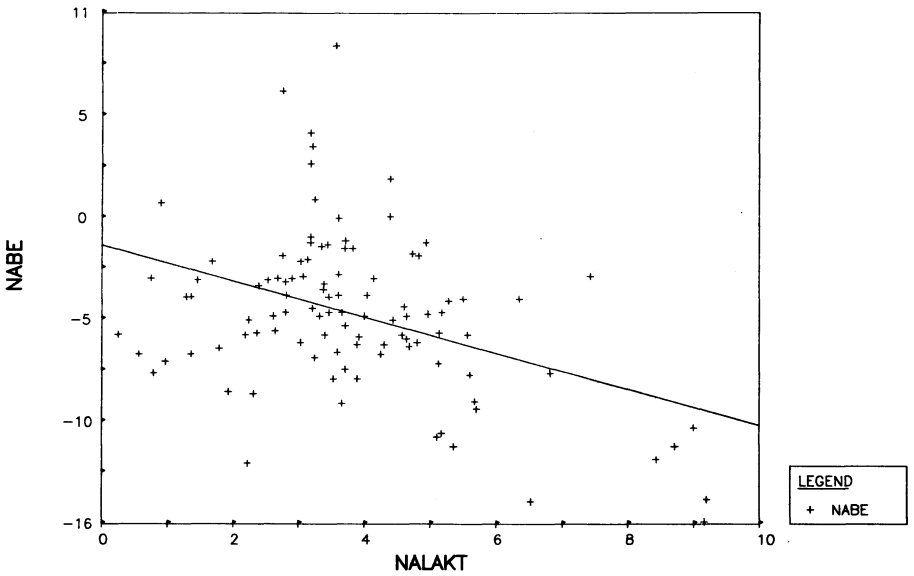

Fig. 4 Correlation between the lactate concentration (mmol/l) and the base excess (BE) in scamples of fetal blood.

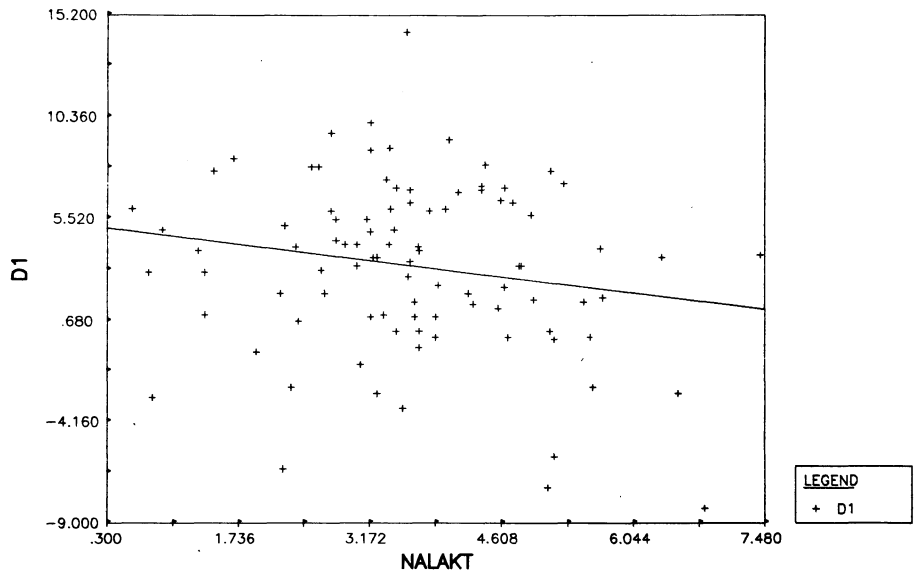

Fig. 5 Correlation between the lactate concentration (mmol/l) and the difference between the fetal and maternal base excess (BE) = D1 (mmol/l).

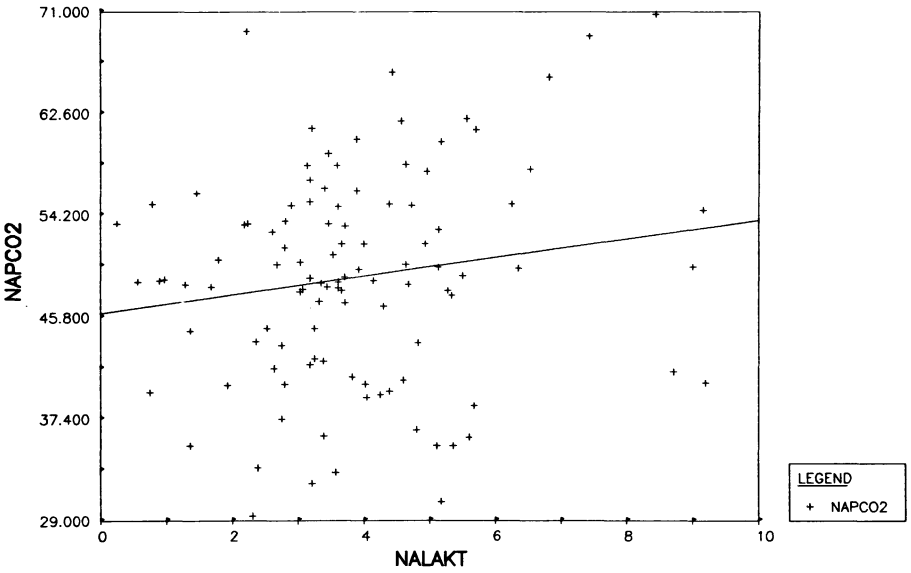

Fig. 6 Correlation between lactate concentration (mmol/l) and P_{CO_2} (mmHg) in samples from the umbilical artery.

Tab. 1 Result of the analysis of the linear correlation (p,r) the positive (ppv) and negative (npv) predictive value, the sensitifity and specificity to detect lactate accumulation (> 3 mmol/l).

		P	r	ppv	npv	sens.	spec.	n	
pH	<	0,00001	- 0,46	92%	34%	31%	93%	108	
pHqu 4o	<	0,00001	- 0,43	90%	3o%	22%	93%	107	
BE	<	0,00001	- 0,40	76%	3o%	41%	65%	104	UA
Diff BE fet-BEmat	<	0,01	- 0,26	31%	71%	87%	14%	101	
Pco_2	>	0,05	- 0,15	90%	31%	23%	93%	107	
Po_2	>	0,05	- 0,12	85%	34%	4o%	82%	101	
pH	≤	0,01	- 0,36	57%	63%	21%	90%	46	
pHqu 4o	≤	0,01	- 0,49	100%	61%	24%	100%	45	
BE	≤	0,01	- 0,45	56%	78%	5o%	82%	34	FBA
Diff BE fet-BE mat	>	0,05	- 0,22	28%	6o%	56%	32%	31	
Pco_2	>	0,05	- 0,07	60%	59%	3o%	83%	38	
Po_2	<	0,01	- 0,44	55%	68%	46%	75%	34	

The results of this calculation is presented in table 1. The highest value for the positive predictive value was calculated for the pH (92%) when considering the values measured in the umbilical artery. The negative predictive value though was calculated to be <50% for all investigated biochemical parameters. The highest value for the specificity during labour was found for the pH qu 40 (93%). The result when calculating the sensitifity was disappointing for all parameters. The best result was achieved by using the difference between fetal and maternal values (87% respectively 56%) for values during labour respectively at the moment of delivery.

Comment

The measurement of lactate concentrations in blood samples from the fetus is still time consuming and cumbersome. Its potential value has been well demonstrated in animal experiments (5).
It is potential to predict the result of the clinical assessment of the newborn has also been approved (7). As the results of this paper implicated there is only limited value of other single parameters to detect lactate concentration of above 3 mmol/l.
The fact that gas values (P_{O_2} and P_{CO_2}) do not correlate with lactate concentrations can be expected from the pathophysiology of acute intrauterine complications as with proceeding lactate accumulation during centralisation of the circulation P_{O_2} might rise again due to the O_2-cunsumption being reduced. The results also demonstrate that materno-fetal blood analysis have a potential in the diagnosis of fetal lactate accumulation (4). Further development though should aim at the development of techniques to measure lactate directly and in a less time consuming way during routine surveillance of the fetus.

References

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